Effects of Genotypes and Storage Time on Quality Parameters of Chinese Flowering Cabbage (Caisim) Planted in Subang

Rahayu,S.T.[a*] **R.Kirana[a]**

[a] *Indonesian Vegetables Research Institute (IVEGRI)*
Jl.Tangkuban Perahu no 517 Lembang Bandung 40391
** Corresponding author: Jl.Tangkuban Perahu no 517 Lembang, Bandung, Indonesia*
Tel.: 0222786245; fax: 0222786416.
swarnit@yahoo.com

Abstract

Chinese flowering cabbage (*Brassica rapa parachinensis)* is one type of leaf vegetables which are rich in fiber, minerals, and vitamins. Postharvest handling techniques and storage will affect the quality of chinese flowering cabbages. This experiment aimed to determine the effect of variety and storage time on quality parameters of chinese flowering cabbages. Chinese flowering cabbage was planted in Subang. The experiment was designed using Randomized design group (RAK) with three replications and two factors. The first factor was variety consisting of 10 varieties and the second factor was storage time were 5 and 10 days. Observations were made on 0, 5, and 10 days. Chinese flowering cabbage was placed in a cold storage at a temperature of 10^{o}C with humidity at 98%. Observing parameters included texture, colour, moisture, ascorbic acid, fiber, and chlorophyll content. The results showed that three varieties on storage for 5 days had good quality parameters.

Keywords: chinese flowering cabbages, quality, storage time, variety

Introduction

Chinese flowering cabbages that is one type of leaf vegetables grows well in Indonesia. Chinese flowering cabbage production and other types of mustard in 2009 were 562.838 tons with a planting area of 56,414 hectares. The plants are most widely grown in West Java, Central Java and North Sumatra provinces (Anonymous, 2010).

There were 22 varieties of chinese flowering cabbages or caisim that have been released by private sectors through introduction. Eventhough IVEGRI has not released any variety of chinese flowering cabbages, the seeds of chinese flowering cabbages line (LV-145) have been distributed to users. LV-145 already has a uniform appearance, but its quality has not been documented well.

Chinese flowering cabbages contain many vitamins and minerals that essential are for our body needs. The nutrient content per 100 gram edible fresh portion moisture 95 g, protein 1.2 g, fat 0.2 g, carbohydrates 1.2 g, vitamin A 5800 IU, vitamin B1 0.04 mg, Vitamin B2 0.07 mg, Niacin 0, 5 mg, ascorbic acid 53 mg, 102 mg Ca, Fe 2 mg, mg 27 mg, P 37 mg, K 180 mg, Na 100 mg. The brassica family includes broccoli, cabbage, kale, cauliflower and brussels sprouts, to prevent many common diseases such as cancer, heart disease, diabetes and hypertension (Siemonsma and Piluek, 1994).

The purpose of storage to maintain the price stability, inhibit the development of biological agents and preserve the quality of the produce in minimal moisture of loss and reduce the respiration (*Dris et al*.,2003).

The purpose of this experiment was to determine the quality of LV-145 and other chinese flowering cabbages line as a preliminary testing.

Materials and Methods

The preliminary testing of chinese flowering cabbage quality was conducted in IVEGRI Research Station in Subang, 100 m above sea level. The treatments were 10 genotypes (five IVEGRI line and five released varieties as control). The experiment was designed using Randomized Design Group (RAK) with three replications. Differentiation among treatments to determine (genotypes) using the F test at 5% level of test. If there was a significant the analysis was continued using LSD test. Plants were grown in mulched beds measuring $3m^2$ using a plant distance of 20 cm x 20 cm with a population of 60 plants for each replication. The first application of fertilizers given were goat manure (10t/ha) and half dose of NPK 16:16:16 (1.5 t/ha). The remaining dose of NPK was given twice as a supplementary fertilizer during the plant growth. In addition, lime, dolomite (1 ton/ha), was applied a week before planting. Pesticides were applied twice a week to control pests, starting two weeks after planting. Pesticides were adjusted to the type of pests that attacked.

Chinese flowering cabbages were kept in cold storage at a temperature of 10^0 C with RH 98%. Observations were conducted on 0, 5 and 10 days. Physical and chemical analyses were conducted in IVEGRI Laboratory. Physical analysis covered texture and colour, while chemical analysis included moisture, ascorbic acid, chlorophyll content, and fiber.

Results and Discussion

Table 1. Analysis of variance of texture, colour, moisture, ascorbic acid,chloropyll, and fiber for genotype

Genotype	Texture (mm/sc/gr)	Colour (N/mm)	Moisture (%)	Ascorbic acid (mg/100gr)	Chlorophyll (µg/mg)	Fiber (%)
1	2.07^{a}	1.18^{a}	92.37^{c}	93.94^{d}	262.42^{cd}	0.99^{ef}
2	2.08^{a}	1.21^{a}	92.36^{c}	94.12^{d}	216.63^{d}	1.10^{d}
3	2.02^{a}	1.26^{a}	92.97^{a}	81.74^{g}	232.05^{d}	1.18^{c}
4	2.05^{a}	1.20^{a}	93.13^{a}	87.04^{f}	245.84^{cd}	1.14^{cd}
5	2.03^{a}	1.23^{a}	92.60^{b}	92.72^{d}	340.11^{b}	1.38^{a}
6	2.02^{a}	1.13^{a}	92.27^{c}	90.25^{e}	376.50^{b}	1.00^{ef}
7	2.16^{a}	1.23^{a}	92.74^{b}	86.27^{f}	245.74^{cd}	0.96^{f}
8	2.00^{a}	1.22^{a}	92.66^{b}	96.19^{c}	282.82^{c}	1.04^{e}
9	2.04^{a}	1.20^{a}	92.18^{c}	106.62^{b}	347.62^{b}	1.32^{b}
10	2.09^{a}	1.21^{a}	91.39^{d}	112.24^{a}	538.55^{a}	1.36^{ab}
HSD 5%	0.30	0.16	0.21	1.84	50.17	0.05

Table 2. Analysis of variance of texture, colour, moisture, ascorbic acid, chlorophyll, and fiber for storage time

Storage Time	Texture (mm/sc/gr)	Colour (N/mm)	Moisture (%)	Ascorbic acid (mg/100gr)	Chlorophyll (µg/mg)	Fiber (%)
0 hari	1.81^{b}	0.89^{c}	92.10^{b}	77.43^{c}	53.99^{c}	0.98^{c}
5 hari	1.91^{b}	1.25^{b}	93.41^{a}	85.80^{b}	498.70^{a}	1.00^{b}
10 hari	2.45^{a}	1.49^{a}	91.89^{c}	119.11^{a}	373.79^{b}	1.46^{a}
HSD 5%	0.12	0.06	0.08	0.73	19.88	0.02

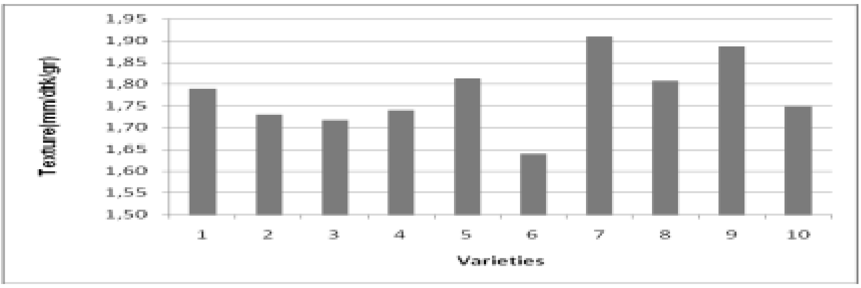

Figure 1. Effect of genotypes on chinese flowering cabbage texture.

Figure 1, the hardest texture was shown by genotype number 6, while the value of the soft texture was shown by genotype number 7. However, from the results of LSD test at 5% level shows that there is no significantly different for all varieties (Table 1). Duration storage affected the texture of chinese flowering cabbage. This was indicated by the value of texture where 5 days storage was significantly different from 10 days storage (Table 2). The longer storage time, the more evaporation from the material occurs that is due to the process of respiration.

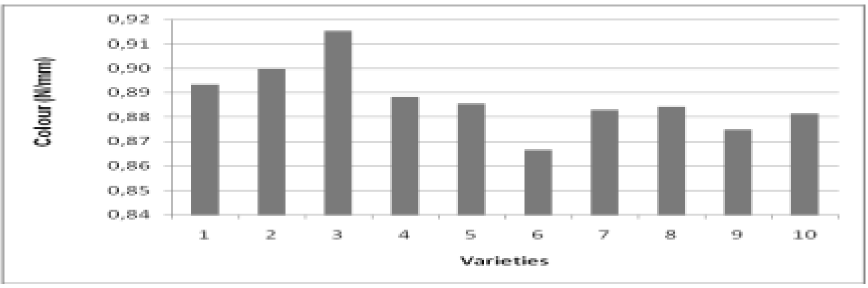

Figure 2. Effect of genotypes on chinese flowering cabbages colour.

Figure 2 shows that genotype number 6 had the lowest value of the colour (dark green), whereas genotype number 3 had the highest colour value (light green).However, the test of LSD at the level of 5% all types of varieties were not significantly different in colour values. The colour influenced by the content of chlorophyll is one of the parameters that affect the appearance of the product. Genotype number 3 had lower chlorophyll content than genotype number 6. Furthermore, colour values were significantly different for 0, 5 and 10 days-storage. During storage, chinese flowering cabbage colour changes because the process of respiration continues. Table 3 shows the genotypes no 3,4, and 5 were not significantly different from control genotypes number 9 and 10 for the colour values in 5 days-storage.

Table 3. Texture, colour, moisture, ascorbic acid, chlorophyll, and fiber for storage time * genotype

ST*Var	Texture (mm/sc/gr)	Colour (N/mm)	Moisture (%)	Ascorbic acid (mg/100gr)	Chlorophyll (µg/mg)	Fiber (%)
ST 0 D VAR1	1.79^{ghij}	0.89^{e}	92.68^{cd}	76.34^{kl}	45.91^{k}	0.92^{jklm}
ST 0 D VAR2	1.73^{hij}	0.90^{de}	92.06^{fghij}	78.44^{jk}	54.67^{k}	0.97^{jkl}
ST 0 D VAR3	1.72^{ij}	0.91^{cde}	92.55^{cde}	73.19^{lmno}	43.27^{k}	0.85^{mno}
ST 0 D VAR4	1.74^{hij}	0.89^{e}	92.81^{c}	72.36^{mno}	41.44^{k}	0.90^{jklm}
ST 0 D VAR5	1.81^{fghij}	0.89^{e}	91.78^{ijk}	88.36^{h}	50.89^{k}	1.01^{ij}
ST 0 D VAR6	$1.91^{bcdefghij}$	0.87^{e}	91.72^{ijk}	67.34^{p}	58.06^{k}	0.95^{jklm}
ST 0 D VAR7	$1.91^{bcdefghij}$	0.88^{e}	91.68^{ijk}	76.34^{kl}	55.91^{k}	0.96^{jklm}
ST 0 D VAR8	1.81^{fghij}	0.89^{e}	91.90^{ghijk}	75.24^{klmn}	57.46^{k}	0.98^{ijk}
ST 0 D VAR9	$1.89^{cdefghij}$	0.87^{e}	92.23^{efgh}	81.44^{ij}	59.18^{k}	0.88^{klm}
ST 0 D VAR10	1.75^{hij}	0.88^{e}	91.62^{kl}	85.22^{hi}	73.14^{k}	1.35^{de}
ST 5 D VAR1	$1.88^{defghij}$	1.24^{abcd}	91.82^{hijk}	97.25^{g}	551.44^{de}	1.08^{hi}
ST 5 D VAR2	$2.17^{abcdefghij}$	1.24^{abcd}	93.88^{b}	71.63^{no}	339.03^{ghi}	0.77^{no}
ST 5 D VAR3	1.84^{efghij}	1.29^{ab}	94.05^{ab}	72.68^{lmno}	393.23^{fg}	1.21^{fg}
ST 5 D VAR4	$1.97^{abcdefghij}$	1.27^{ab}	94.32^{a}	75.82^{klm}	375.21^{fgh}	0.94^{jklm}
ST 5 D VAR5	1.84^{efghij}	1.27^{ab}	94.02^{ab}	84.71^{hi}	577.60^{cd}	1.33^{de}
ST 5 D VAR6	1.64^{j}	1.12^{bcde}	93.88^{b}	71.11^{op}	410.63^{fg}	0.75^{o}
ST 5 D VAR7	$2.04^{abcdefghij}$	1.24^{abcd}	93.72^{b}	75.81^{klm}	409.41^{fg}	0.59^{p}
ST 5 D VAR8	1.81^{fghij}	1.25^{abc}	93.72^{b}	83.14^{i}	457.04^{ef}	0.87^{lmn}
ST 5 D VAR9	$1.92^{bcdefghij}$	1.26^{ab}	92.65^{cde}	100.91^{g}	629.84^{bcd}	1.19^{gh}
ST 5 D VAR10	$2.02^{abcdefghij}$	1.29^{ab}	92.08^{fghi}	124.96^{d}	843.56^{a}	1.30^{def}
ST 10 D VAR1	2.55^{a}	1.40^{ab}	92.63^{cde}	108.24^{f}	189.89^{j}	0.96^{jklm}
ST 10 D VAR2	$2.35^{abcdefgh}$	1.48^{a}	91.15^{m}	132.28^{b}	256.19^{ij}	1.56^{b}
ST 10 D VAR3	2.50^{abcd}	1.56^{a}	92.31^{defg}	99.35^{g}	259.65^{ij}	1.47^{bc}
ST 10 D VAR4	2.45^{abcde}	1.44^{ab}	92.27^{defg}	112.94^{e}	320.86^{ghi}	1.58^{b}
ST 10 D VAR5	2.43^{abcdef}	1.54^{a}	92.00^{fghijk}	105.10^{f}	391.84^{fg}	1.79^{a}
ST 10 D VAR6	2.49^{abcd}	1.42^{ab}	91.20^{lm}	132.29^{b}	660.82^{bc}	1.31^{def}
ST 10 D VAR7	2.52^{ab}	1.55^{a}	92.81^{c}	106.67^{f}	271.89^{hij}	1.33^{de}
ST 10 D VAR8	$2.40^{abcdefg}$	1.51^{a}	92.37^{def}	130.20^{bc}	333.96^{ghi}	1.26^{efg}
ST 10 D VAR9	$2.32^{abcdefghi}$	1.48^{a}	91.65^{jk}	137.52^{a}	353.84^{fghi}	1.88^{a}
ST 10 D VAR10	2.50^{abc}	1.47^{a}	90.47^{n}	126.54^{cd}	698.94^{b}	1.41^{cd}
HSD 5%	0.62	0.34	0.43	3.87	105.60	0.11

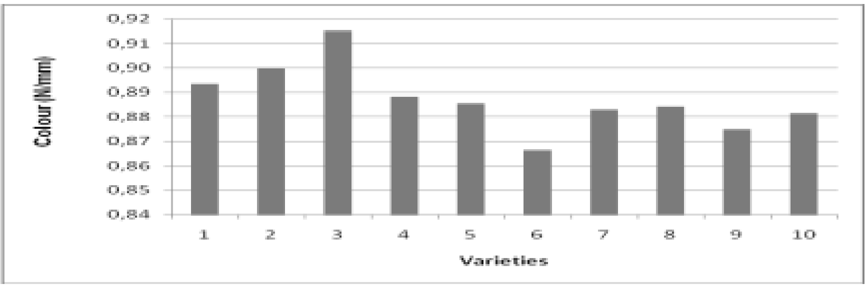

Figure 2. Effect of genotypes on chinese flowering cabbages colour.

Figure 2 shows that genotype number 6 had the lowest value of the colour (dark green), whereas genotype number 3 had the highest colour value (light green).However, the test of LSD at the level of 5% all types of varieties were not significantly different in colour values. The colour influenced by the content of chlorophyll is one of the parameters that affect the appearance of the product. Genotype number 3 had lower chlorophyll content than genotype number 6. Furthermore, colour values were significantly different for 0, 5 and 10 days-storage. During storage, chinese flowering cabbage colour changes because the process of respiration continues. Table 3 shows the genotypes no 3,4, and 5 were not significantly different from control genotypes number 9 and 10 for the colour values in 5 days-storage.

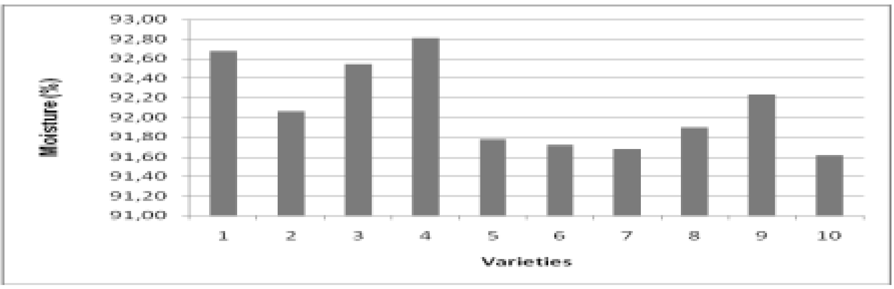

Figure 3. Effect of genotypes on chinese flowering cabbages moisture.

Chinese flowering cabbage moisture was significantly affected by genotypes. Figure 3 shows genotype number 4 was the highest water content, whereas the lowest levels of water contained was genotype number 10. Moisture was inversely related to chlorophyll and fiber content of which is a component of dissolved solids in chinese flowering cabbages. The moisture of genotype number 5 was not significantly different from control genotype number 7 and 8. Table 2 also shows that moisture values were significantly different between 5 and 10 days-storage.

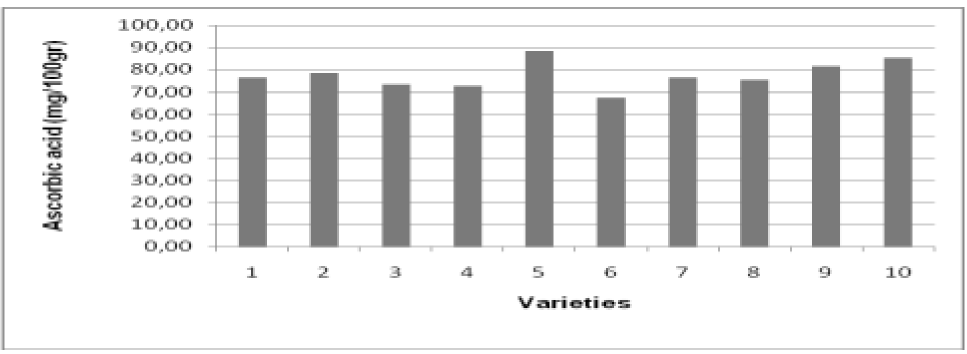

Figure 4. Effect of genotypes on chinese flowering cabbages ascorbic acid

Figure 4 shows that the ascorbic acid content in genotype number 5 was the highest value. Ascorbic acid is affected by the type of varieties and seasons (Hanson *et al*.,2011). Genotypes number 1,2 and 5 were not significantly different in ascorbic acid contents. Ascorbic acid is one of the components with high nutritional value in chinese flowering cabbages as other cabbage type vegetables such as broccoli (Jagdish Singh *et al*.,2007). During storage ascorbic acid becomes unstable (Hounsome *et al*., 2009) as also indicated in Table 2. However, genotypes number 3.5, 6, and 7 showed the values of ascorbic acid contents were relatively stable for 5 days-storage (Table 3).

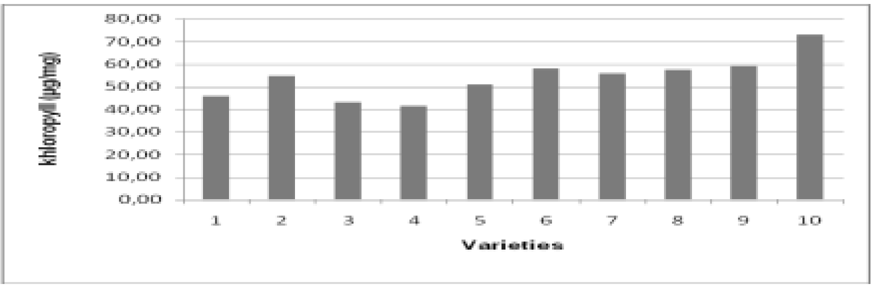

Figure 5. Effect of genotypes on chinese flowering cabbages chlorophyll content

Genotype number 10 had the highest chlorophyll content (Figure 5). The chlorophyll content affected the colour of the leaves that made it become greener. The chlorophyll content of genotype number 5 was not significantly different from control genotype number 6 and 9. While genotypes number 1 and 4 were not significantly different from control genotype number 7. The content of chlorophyll rapidly declines during storage. Storage in the dark room will decrease the speed of leaf colour change from green to yellow (Zhang *et a*l., 2011, In Press).

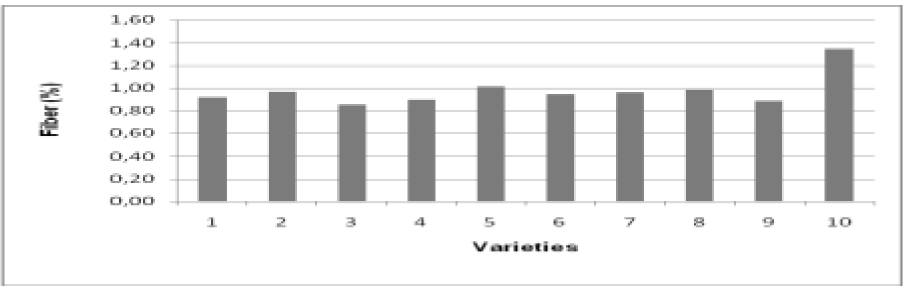

Figure 6. Effect of genotypes on chinese flowering cabbages fiber

Fiber content of genotype number 10 had the highest value. Genotype number 5 was not significantly different from genotype number 10, as well as the interaction 5 days-storage and genotype varieties were not significantly different for number 5 and 10.

Conclusion

1. Genotypes of chinese flowering cabbage gave effects on moisture, ascorbic acid, chloropyll, and fiber of chinese flowering cabbages
2. Storage time gave effects on texture, colour, moisture, ascorbic acid, chlorophyll, and fiber of chinese flowering cabbage.
3. Three genotypes still had good qualits up to 5 days on cold storage.

References

Anonymous, 2010. Statistik Indonesia. Biro Pusat Statistik. Jakarta.220-225.

Dris, R., Niscanen, R., and Jain, S. M. 2003. Crop Management and Postharvest Handling of Horticultural Product Volume II Fruits and Vegetables. Science Publishers, Inc, Enfield NH. USA. Pp 1-22 and 89-106

Hanson P, Yang, R-Y., Chang, L-C., Ledesma, L. ,and Ledesma, D**.** 2011. Carotenoids, ascorbic acid, minerals, and total glucosinolates in Choysum (*Brassica rapa* cvg. *parachinensis*) and Kailaan (*B. oleraceae* Alboglabra group) as affected by variety and wet and dry season production. *Journal of Food Composition and Analysis.* 24(&): 950-962.

Hounsome, N., Hounsome, B., Tomos, D. and Edwards-Jones, G**.**2009. Changes in antioxidant compounds in white cabbage during winter storage. *Postharvest Biology and Technology* 52(20):173-179.

Jagdish Singh, A.K. et al. 2007. Variability of carotenes, vitamin C, E and phenolics in *brassica v*egetables. *Journal of Food Composition and Analysis*. 20 (2): 106-112

Siemonsma,J.S. and Piluek,K(Editors).1994. Plant Resources of South- East Asia 8 Vegetables. Prosea Foundation . Bogor, Indonesia. Pp.123-126

Zhang, X., Zhang, Z., Li, J., Wu, L., Guo, J., Ouyang, L., Xia, Y., Huang, X., and Pang, X. 2011. Correlation of leaf senescence and gene expression/activities of chlorophyll degradation enzymes in harvested chinese flowering cabbage (*Brassica rapa* var. parachinensis). *Journal of Plant Physiology*. Article in Press.

-- back to Table of Content --